Questions 1 – 6 pertain to the Case Study

1. (7 points) NOC's cash requirements have increased considerably in 2001.

The CFO proposed to make, on June 30, 2001 a surplus withdrawal from the pension fund of the National Oil Full-Time Salaried Pension Plan equal to the expected growth of the surplus during 2001.

The CFO's model for determining the surplus withdrawal is:

- Surplus withdrawal = [Expected Surplus @ 1/1/2002] minus [Surplus @ 1/1/2001]
- Expected Surplus @ 1/1/2002 = [Expected Assets @ 1/1/2002] less [Expected Liability @ 1/1/2002]
- Expected Assets @ 1/1/2002 = [Assets @ 1/1/2001] * [1 + expected return on the fund]
- Expected Liability @ 1/1/2002 = [Liability @ 1/1/2001] * [1 + discount rate used to determine the liability]
- The liability to be used is the projected benefit obligation determined under the expense valuation

The investment managers provided the CFO with an expected return on the fund of 8.83%.

(a) Explain and calculate the effect of the CFO's proposal on the 2001 pension expense, and year-end balance sheet liability. Treat the surplus withdrawal as a negative contribution. Show all work.

(b) Critique the model proposed by the CFO.
2. (11 points) NOC wants to introduce post-retirement indexing for participants in the National Oil Full-Time Salaried Pension Plan. NOC is looking for a provision that is relatively easy to administer and allows NOC to control cost in periods of high inflation.

You are given:

<table>
<thead>
<tr>
<th>Participants</th>
<th>Years of Service</th>
<th>Average Years to Vesting</th>
<th>Projected Benefit Obligation (PBO) as at 1/1/2001</th>
<th>Increase in PBO for 1% per year indexing after retirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active 0 to 3</td>
<td>4</td>
<td>$1,236,151</td>
<td>$75,000</td>
<td></td>
</tr>
<tr>
<td>Active 3 to 5</td>
<td>1</td>
<td>8,000,000</td>
<td>550,000</td>
<td></td>
</tr>
<tr>
<td>Active 5 or more</td>
<td>-</td>
<td>446,500,000</td>
<td>31,000,000</td>
<td></td>
</tr>
<tr>
<td>Deferred vested</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Pensioners</td>
<td>-</td>
<td>95,541,600</td>
<td>6,100,000</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$551,277,751</strong></td>
<td><strong>$37,725,000</strong></td>
<td></td>
</tr>
</tbody>
</table>

The service cost increases by 7% for each 1% per year indexing after retirement.

(a) Evaluate alternative approaches for indexing the National Oil Full-Time Salaried Pension Plan.

(b) Describe how the plan’s asset allocation should change if NOC adopts automatic indexation.

(c) Describe how NOC’s actuarial assumptions may change if NOC adopts automatic indexation.

(d) Explain and calculate the effect on the 2001 pension expense of providing automatic indexation equal to 100% of CPI. Use the current actuarial assumptions.

Show all work.
3. **(14 points)** Belair has introduced a mandatory social insurance program called "BelairCare". It provides a monthly retirement benefit payable at age 70 equal to $20 per month times years of full-time employment over the worker's entire career. The $20 is indexed annually by the percentage increase in the national average wage. It also provides all citizens age 70 or over with benefits equal to 50% of all covered medical expenses.

BelairCare is funded by a 6% employer plus a 6% employee payroll tax.

(a) Describe the actuarial assumptions you would need to do a cash-flow projection for BelairCare.

(b) Evaluate the BelairCare design from the perspective of the covered workers.

(c) Given that NOC’s Full-Time Salaried and Union Retiree Health Benefit Program provides benefits equal to 75% of all covered medical expenses, after a $100 deductible, evaluate alternative approaches for integrating these benefits with BelairCare.
Questions 1 – 6 pertain to the Case Study

4. (11 points) The Board of Directors of NOC has decided to force the current CEO to take early retirement on January 1, 2001. The Board will provide an enhanced pension benefit to the departing CEO.

Information on the current CEO as of January 1, 2001:

- Age: 57
- Service: 20 years
- Average future working lifetime: 4.1 years
- SRP Service Cost: $70,000
- SRP PBO before departure: $1,225,000
- SRP PBO after departure (before enhancement): $970,000
- SRP PBO after departure (after enhancement): $1,235,000

The Board has decided to bring in a new CEO from the outside. The prospective CEO, age 45, has been participating for the last 20 years in retirement plans which are similar to those at NOC.

(a) Determine the effect of the CEO’s retirement on NOC’s balance sheet and expense.

(b) Describe the issues that NOC should consider in designing the new CEO's retirement package.

(c) Describe ways to fund these benefits and their tax implications.
5. (10 points) NOC’s salaried employees are requesting a DC ERP in addition to the existing DB ERP.

NOC’s CFO is considering the following for a new salaried employees' DC ERP:

- employer contribution rate of 3% of salary,
- all other design features are the same as NOC's Part-Time DC Pension Plan, and
- the plan will supplement the existing Full-Time Salaried Pension plan.

(a) Explain the issues associated with supplementing an existing DB ERP with a DC ERP. Propose alternatives where appropriate.

(b) Critique the design features in the proposed DC ERP. Recommend any changes. Justify your recommendations.

(c) Identify the differences in fiduciary responsibilities in selecting investments for a DC ERP versus a DB ERP.
6. (7 points) NOC's union employees hired an actuary to review the funded status of the National Oil Full-Time Hourly Union Pension Plan. In the actuary's opinion, the funding recommendation should be determined on a termination basis. On this basis, the plan is underfunded by $150 million.

Assume that actuarial standards in Belair are consistent with those in the U.S. and Canada.

(a) Explain the differences between the deficit on a termination basis and that shown in the January 1, 2001 funding valuation.

(b) Describe the long-term consequences of funding the National Oil Full-Time Hourly Union Pension Plan on a termination basis.

**END OF EXAMINATION**
Morning Session
7. (7 points) After a recent economic decline, NOC’s CFO has stated that he would like a 95% assurance that the National Oil Full-Time Salaried Pension Plan will maintain a surplus on an expense basis in the short term.

You are given:

- The expense discount rate will be increased to 7.5% on December 31, 2001
- Benefit payments will remain level from 2000
- Active employees' service cost has a duration of 14
- The duration for the total Pension Benefit Obligation (PBO) is 10
- No contributions are to be made during 2001

Using the PBO as your liability measure:

(a) (1 point) Calculate the Plan's Funding Ratio Return (FRR) for 2000.

(b) (2 points) Estimate the expected funded status of the Plan at the end of 2001 assuming the return on assets is zero.

(c) (4 points) Given the CFO's objective, evaluate the following asset allocations using the concept of FRR:

- 100% bond and 0% equity
- 50% bond and 50% equity
- 0% bond and 100% equity
Questions 7 –10 pertain to the Case Study

8.  

(7 points)  The government of Belair intends to change the tax status of ERPs and PPAs in order to increase tax revenue, without discouraging retirement savings in general.

Comment on the government's objectives and propose ways in which Belair's rules could be changed or clarified to meet these objectives.

9.  

(10 points)  NOC’s union is proposing to freeze the NOC Full-Time Hourly Union Pension Plan and start participation in the multiemployer plan maintained for the members of the Oil Workers Union (OWU). The OWU Plan has a surplus on a going concern basis but a deficit on a termination basis.

(a)  (7 points)  Analyze the risks and benefits for NOC if they accept the Union's proposal. Include both financial and operational considerations.

(b)  (3 points)  Describe the additional considerations if the existing NOC Hourly Union Pension Plan were merged into the OWU plan.
Questions 7–10 pertain to the Case Study

10. *(6 points)* On January 1, 2001, National Oil acquired World Oil, a large refinery in Belair. National Oil will retain all of the salaried employees of World Oil.

World Oil has a number of salaried employees that are sent abroad for temporary assignments. Some, but not all of these employees are from Belair.

World Oil's current salaried employees’ retirement programs and workforce are described below.

**Retirement Income Benefit**
- Defined Contribution
- Eligibility: Immediate
- Vesting: Immediate
- Employer contribution: 3% of pay
- Investment option: Balanced fund
- Loans: None permitted
- Account balance paid on retirement, termination, death or disability

Reconciliation of Plan Assets from 1/1/2000 to 1/1/2001

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets as of January 1, 2000:</td>
<td>$18,789,300</td>
</tr>
<tr>
<td>Employer contributions:</td>
<td>2,801,200</td>
</tr>
<tr>
<td>Benefit payments:</td>
<td>(1,550,100)</td>
</tr>
<tr>
<td>Expenses paid by the plan:</td>
<td>0</td>
</tr>
<tr>
<td>Investment return:</td>
<td>601,200</td>
</tr>
<tr>
<td>Assets as of January 1, 2001:</td>
<td>$20,641,600</td>
</tr>
</tbody>
</table>

**Retiree Healthcare**
- Self-insured defined benefit plan
- Retiree contributions: None
- Eligibility: Retirement at or after age 55 with at least 10 years of service
- Hospital and major medical benefits: all fees paid by plan
- Dental: Plan pays 100% of preventive care and 50% of restorative care

**Retiree Life Insurance**
- Fully-insured benefit
- Eligibility: Retirement at or after age 55 with at least 10 years of service
- Employer-paid benefit: $25,000
- Optional retiree-paid benefit: $25,000 or $50,000
10. **(CONTINUED)**

*Census Data*

<table>
<thead>
<tr>
<th></th>
<th>In Belair</th>
<th>Abroad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of salaried employees:</td>
<td>2,250</td>
<td>150</td>
</tr>
<tr>
<td>Average age:</td>
<td>36</td>
<td>43</td>
</tr>
<tr>
<td>Average service:</td>
<td>11 years</td>
<td>7 years</td>
</tr>
<tr>
<td>Average earnings</td>
<td>$41,500</td>
<td>$85,000</td>
</tr>
</tbody>
</table>

Retired participants in the life and health plans: 750 with family coverage, 150 with single coverage
Average age: 72

National Oil has asked you to integrate the NOC and World Oil retirement programs such that all salaried employees are receiving consistent benefits.

(a) Describe the issues in integrating these programs.

(b) Describe the additional issues for the salaried employees working abroad.

**END OF EXAMINATION**

Afternoon Session
1. (8 points) A new Company has established a contributory pension plan on January 1, 2001. You are given:

**Plan Provisions**

- **Retirement benefit:** The greater of:
  - (i) 2% of career average earnings, or
  - (ii) actuarial equivalent of 200% of employee contributions accumulated at the fund rate of return
- **Normal form of payment:** 5 years certain and life thereafter, payable monthly in advance
- **Normal retirement age:** 65
- **Employee contributions:** 4% of annual earnings, payable at the beginning of the year
- **Termination or death benefit:** Lump sum payment of 200% of employee contributions accumulated at the fund rate of return
- **Actuarial equivalence:** At valuation assumptions

**Actuarial Assumptions and Methods**

- **Interest rate:** 6.5% per annum
- **Retirement age:** 65
- **Salary increases:** 4.0% per annum
- **Termination rates:**
  - Attained Age
  - Year-end rates
  - Up to 34
  - 10%
  - 35 and over
  - 0%
- **Other pre-retirement decrements:** None
- **Actuarial cost method:** Unit Credit
- **Actuarial value of assets:** Market value

\[ \bar{a}_{65}^{(12)} = 10.4 \]
1. (CONTINUED)

Participant Data

<table>
<thead>
<tr>
<th></th>
<th>Group J</th>
<th>Group K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of employees</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Age at 1/1/2001</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>2001 earnings per</td>
<td>$40,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>employee</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(a) Calculate the employer normal cost for 2001.


Determine the plan’s assets and accrued liability at January 1, 2002.

(c) Calculate the gains and losses by source for 2001.

Show all work.
2. (4 points) The CEO of ABC Company will receive a pension on retirement at age 65.

You are given the following as at January 1, 2001:

- CEO’s Age: 50
- CEO’s Service: 10 years
- CEO’s Salary: $300,000 per annum
- Pension Benefit: 2% of final year’s salary times years of service
- Form of Payment: Life only, payable monthly in advance

The pension is paid from a basic plan and a supplemental executive plan. The maximum annual pension payable under the Basic Plan is $2,000 times years of service. The remainder is paid from the Supplemental Plan. ABC pre-funds the CEO’s entire pension.

**Actuarial Assumptions and Method**

<table>
<thead>
<tr>
<th></th>
<th>Basic Plan</th>
<th>Supplemental Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest rate:</td>
<td>8% per annum</td>
<td>6% per annum</td>
</tr>
<tr>
<td>Salary scale:</td>
<td>5% per annum</td>
<td>5% per annum</td>
</tr>
<tr>
<td>Normal retirement age:</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Pre-retirement decrements:</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Actuarial Cost Method:</td>
<td>Projected Unit Credit (prorated on service)</td>
<td>Entry Age Normal (level % of pay)</td>
</tr>
<tr>
<td>$a_{65}^{(12)}$</td>
<td>9.0</td>
<td>11.0</td>
</tr>
</tbody>
</table>

(a) Calculate the normal cost for the Basic Plan at January 1, 2001.

(b) Calculate the normal cost for the Supplemental Plan at January 1, 2001.

Show all work.
3. (8 points) You are the actuary for a company that sponsors a non-contributory defined benefit pension plan.

You are given:

Plan Provisions
- Retirement benefit: $20 per month, per year of service
- Normal form of pension: Life only, payable monthly in advance
- Normal retirement age: 60
- Early retirement reduction: 5% per year that retirement precedes age 60
- Other ancillary benefits: None

Actuarial Assumptions and Method
- Interest rate: 7.0% per annum
- Retirement rates: 10% per annum, at the beginning of each year, from age 57 through 59; 100% at age 60
- Pre-retirement decrements: None
- Actuarial cost method: Unit Credit

\[
\begin{align*}
\dd{a}_{57}^{(12)} & = 10.0 \\
\dd{a}_{58}^{(12)} & = 9.0 \\
\dd{a}_{59}^{(12)} & = 8.0 \\
\dd{a}_{60}^{(12)} & = 7.0 \\
\end{align*}
\]

Financial Information
- Assets at January 1, 2001: $100,000
- 2001 employer contribution: None
- Fund rate of return in 2001: 2%

Participant Data as at January 1, 2001

<table>
<thead>
<tr>
<th>Member</th>
<th>Age</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jean</td>
<td>57</td>
<td>25</td>
</tr>
<tr>
<td>Kelly</td>
<td>58</td>
<td>29</td>
</tr>
</tbody>
</table>
3. **(CONTINUED)**

(a) Calculate the unfunded accrued liability and normal cost as at January 1, 2001.

(b) On December 31, 2001, Kelly retires. On December 31, 2001, Pat transfers into the plan at age 45 and $10,000 is transferred to recognize 10 years of Pat’s prior service.

   Calculate the unfunded accrued liability as at January 1, 2002.

(c) Calculate the gains and losses by source for 2001.

Show all work.
4. (4 points) You are the actuary for a company that sponsors a defined benefit pension plan.

You are given:

**Plan Provisions**
- Retirement benefit: $30 per month, per year of service
- Normal form of payment: Five years certain and life thereafter, payable monthly in advance
- Optional form of payment: Actuarially equivalent 75% joint and survivor annuity
- Normal retirement age: 65
- Early retirement reduction: Actuarial equivalence
- Other ancillary benefits: None
- Actuarial equivalence: Based on valuation assumptions

**Actuarial Assumptions and Method**
- Interest rate: 7.0% per annum
- Retirement age: 65
- Pre-retirement decrements: None
- Actuarial cost method: Entry Age Normal

<table>
<thead>
<tr>
<th>Member</th>
<th>Spouse</th>
<th>Member: Spouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{a}_{60}^{(12)} = 10.8387$</td>
<td>$\bar{a}_{57}^{(12)} = 12.5296$</td>
<td>$\bar{a}_{60:57}^{(12)} = 9.7460$</td>
</tr>
<tr>
<td>$\bar{a}_{65}^{(12)} = 9.7004$</td>
<td>$\bar{a}_{62}^{(12)} = 11.6834$</td>
<td>$\bar{a}_{65:62}^{(12)} = 8.5126$</td>
</tr>
<tr>
<td>$\bar{a}_{70}^{(12)} = 8.4642$</td>
<td>$\bar{a}_{67}^{(12)} = 10.6379$</td>
<td>$\bar{a}_{70:67}^{(12)} = 7.1863$</td>
</tr>
</tbody>
</table>

$sp_{60} = 0.9446$
$sp_{65} = 0.9039$

The following member retires on January 1, 2001:

<table>
<thead>
<tr>
<th>Data as at January 1, 2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member’s age: 60</td>
</tr>
<tr>
<td>Spouse’s age: 57</td>
</tr>
<tr>
<td>Years of service: 35</td>
</tr>
</tbody>
</table>
4. (CONTINUED)

(a) Calculate the experience gain or loss on January 1, 2001 caused by the retirement of the member.

(b) Calculate the member’s pension under the optional form of payment.

Show all work.
5. 

(6 points) Your client sponsors a non-contributory defined benefit pension plan.

You are given:

**Plan Provisions**
- Retirement benefit: 1.5% of career average earnings
- Normal form of payment: Life only, payable monthly in advance
- Normal retirement age: 65
- Earliest retirement age: 55
- Early retirement reduction: 3% per year that retirement precedes age 65

**Actuarial Assumptions**
- Interest rate: 6.5% per annum
- Salary increase rate: 4.0% per annum
- Retirement age: 60
- Pre-retirement decrements: None
- Actuarial value of assets: Market value

\[ a^{(12)}_{60} = 11.4 \]

Assets at January 1, 2001 equal the January 1, 2001 Unit Credit accrued liability.

**Participant data as at January 1, 2001**

<table>
<thead>
<tr>
<th>Members</th>
<th>Age</th>
<th>Service (Years)</th>
<th>2001 Earnings</th>
<th>Accrued Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>41</td>
<td>11</td>
<td>$50,000</td>
<td>$6,000</td>
</tr>
<tr>
<td>K</td>
<td>53</td>
<td>18</td>
<td>60,000</td>
<td>12,000</td>
</tr>
</tbody>
</table>

(a) Determine the normal cost under the Frozen Initial Liability method given that this method was adopted on January 1, 2001.

(b) Determine the normal cost under the Individual Aggregate cost method, assuming that assets allocated to each member equal their respective Unit Credit accrued liability.

Show all work.

**END OF EXAMINATION**